Sample changer system experiments on the ECDF of ^{234}Am and He-jet transport efficiency

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The Sample Changer System (SCS) was designed to rapidly transport activity from a target chamber to a detector counting position. Initially, the SCS is being used to study the electron-capture delayed-fission (ECDF) process of neutron deficient actinides. The overall effectiveness of the SCS was tested by running two experiments in 1997.

The first experiment was an ECDF experiment with ^{234}Am produced via the ^{237}Np(α,7n)^{234}Am reaction with 80 MeV projectiles. We attached a 150 ft. capillary tube to an existing He-KCl gas transport system that has been used in numerous other heavy-element experiments.[1] We mounted twelve ^{237}Np targets in the LIM target system.[2]

This experiment used a Gammasphere[3] setup with 99 HPGe detectors and 2 germanium x-ray LEPS detectors. In addition, we had 2 Si particle detectors positioned directly above and below the source. We counted each sample for 4 minutes, about 1.75 half-lives of the ^{234}Am isotope.

The mechanical systems of the SCS were fairly reliable once some minor adjustments were made. However, we did have difficulty with the SCS activity collection site. Our overall event rate was considerably lower than that seen by Hall who studied the identical system with fewer detectors.[4] This led us to believe that we had a problem collecting activity on the polypropylene foils.

We then designed an experiment to test the efficiency of the collection site of the SCS. We measured the 4.8 min. half-life activity from ^{221}Fr and its 32 ms daughter ^{217}At deposited on polypropylene foils after traveling through the He aerosal transport system from a recoil source chamber.

We first measured the efficiency of the collection site under the conditions present during the Gammasphere experiment. We regulated the vacuum pressure at the collection site to obtain the value achieved during the Gammasphere run---0.89 atm. We collected activity for 150 seconds and measured the counts under the 7.1 MeV ^{217}At peak for 600 seconds. The ^{217}At peak was chosen because it was much cleaner than the 6.1-6.3 MeV ^{221}Fr peak region.

We tested several other setups to try to maximize the efficiency at the collection site. We made adjustments to the vacuum systems, the capillary tube length, and the diameter of vacuum holes at the collection site.

Absolute yields were calculated by comparing the experimental delayed fission rate to a rate calculated with a published fission cross section.[5] Using this value, the absolute transport/collection efficiency during the Gammasphere experiment was 13.7--17.6%. The most effective setup used a Varian 660 Scroll Pump and a 150 ft. capillary tube giving an absolute yield of 60.5--82.1%. This more efficient setup will be used in our February 1998 experiment.

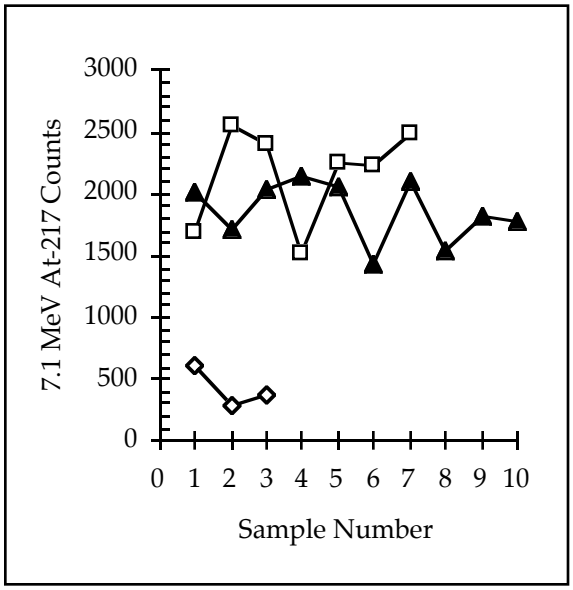

Fig. 1. Yield of ^{217}At using 3 systems: *boxes* = yield check direct catch, *triangles* = improved Scroll pump setup, *diamonds* = Gammasphere setup.

Footnotes and References

1. D.C. Hoffman, Radiochim Acta. 72, 1 (1996).
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